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Association of Obesity with the Lower Limbs Osteoarthritis in a Community of Women from El Jadida Province in Morocco

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ABSTRACT

Background: In the last years, obesity became of interest because of its association with osteoarthritis (OA) which is increasing with the increase of both life expectancy and the prevalence of obesity. **Aims:** The objective was to assess the association of obesity with the susceptibility of the lower limbs OA (LLOA) occurrence in women. **Subjects and Methods:** The symptomatic susceptibility of the onset of LLOA was evaluated on a sample of women from El Jadida (Morocco) using the Moroccan version of the Western Ontario and McMaster Universities osteoarthritis index (WOMAC) for the lower limbs. Sociodemographic and anthropometric data were collected too using a questionnaire. **Results:** The surveyed female population was 45±13 years old mostly obese (77%) with an average BMI: 29.18 ± 5.29 and a WHR: 0.93 ± 0.9. The susceptibility of the LLOA in both forms (knee and coccyx osteoarthritis) was highly prevalent in women older than 50 years (22%). The three dimensions of WOMAC (pain, stiffness and functional impairment) are felt much more among postmenopausal 44.37±26.67 (with a rate of 49%) than procreating women 29.58±22.44 (with a rate of 51%) among women with morbid obesity (69.40±8.27) than normal weight (31.67±4.40) and in women having android (86.13%) than those with a gynoid obesity morphotype (5.10%). **Conclusions:** The results report an association of obesity with the risk of osteoarthritis occurrence varying with age and OA location hence the importance of preventing osteoarthritis issues through the management of obesity.

Keywords: Knee osteoarthritis, Coccyx osteoarthritis, WOMAC, Obesity, BMI, WHR.

1 Introduction

Obesity has become a major health issue associated with an increased risk of morbidity and mortality. According to the World Health Organization (WHO), more than 1.9 billion overweight adults have been registered in the year 2016 [1]. In Morocco, it is estimated that overweight is prevalent in 30% and obesity in 14% of the population [2]. Obesity has attracted considerable interest in recent years because of its potential variability and association with osteoarthritis [3]. The latter is defined as a disease of the entire articulation and its environment, compromising people status to move without feeling pain or maintain their physical activity. However, osteoarthritis remains largely underestimated by health authorities everywhere.

In Morocco, osteoarthritis constitutes 16% of rheumatology service visits [4] and represents a significant cause of disability whose prevalence is not precise. Due to the aging of the population and the increased prevalence of obesity, the frequency of osteoarthritis continues to grow, with a significant socio-economic impact due to its frequent association with other serious diseases [5].

The prevalence of osteoarthritis increases significantly with age and is further aggravated by obesity [6]. This tendency to worsen the osteoarthritis's complications is also observed with age and the different prevalence for each sex after menopause [7]. Admittedly, the detrimental effect of obesity is stronger in women compared to men and is more related to bilateral than unilateral involvement of all compartments of the knee [8].

Among the determinants of osteoarthritis, there are multiple mechanical and biochemical factors, but obesity plays a key role in bearing as well as no–bearing articulations [9].

In addition, obesity is an important risk factor involved in the etiology of osteoarthritis by the aggravation of the mechanical constraints exerted on the articulation. Indeed, obese or overweight people are more likely to suffer from knee and hip osteoarthritis [10] with varying degrees of the impairment of their quality of life [11].

Knee osteoarthritis is particularly highly related to obesity. Furthermore, the risk of developing this form of osteoarthritis was also associated with body mass index (BMI) by several epidemiological studies [12]. Indeed, one kilogram per square meter in excess of a BMI of 27 increases the risk of osteoarthritis in women by 15% [13]. On the other hand, the development of osteoarthritis is also linked to adipose tissue responsible for ~~the~~ metabolic disorders linked to body weight excess and mechanical stress on cartilage [14].

In addition, the causal link between obesity and the risk of hip osteoarthritis remains less obvious, especially for bilateral forms [15]. Being overweight constitutes a factor that aggravates symptoms leading more quickly to arthroplasty.

In the current study, the aim was to examine the association between obesity and the risk of osteoarthritis of the lower limbs based on the clinical symptomatology perceived by WOMAC in its Moroccan version, in a population of women living in El Jadida province of Morocco.

2. Population and Methods

2.1 Population

The study was carried on an agricultural community of women that have agreed to take part in this investigation going from the 01/03/2017 to 31/08/2017 on women recruited. The sample was selected randomly from both urban and rural residence areas. The survey concerned all women among those residents for more than six months of the 11 localities of the province.

2.2 Methods

Two questionnaires were utilized for the data collection. The first includes the age of answering, the age of procreation, and the anthropometric measurements. While the second questionnaire aimed to collect information to assess the susceptibility of osteoarthritis. The Western Ontario and McMaster Universities Questionnaire (WOMAC) constituted a validated index, widely used for assessing osteoarthritis of the lower limbs that has been trans-culturally adapted to the Moroccan dialect [16,17]. The questionnaire makes it possible to capture the specific aspects perceived by the recruited participants who may suffer from knee osteoarthritis and/or hip osteoarthritis in order to provide information on the pain occurrence, stiffness and functional limitations induced by osteoarthritis. The score of each of its included 24 questions was measured with a Lickert scale with 5 possible answers ranging from 0 (no annoyance) to 4 (maximum discomfort). A higher score for each subscale corresponds to a worse condition. The pain sub-scale includes five questions about the degree of pain (e.g., walking pain), with a sub-score ranging from 0 to 20. The stiffness subscale includes two questions about the severity of the stiffness (after the first wake up, and later in the day), with a sub-score ranging from 0 to 8. For the functionality, the sub-scale includes 17 questions about the degree of difficulty expressed when carrying out activities (e.g. going downstairs), this sub-score ranges from 0 to 68 [18]. Data on the respondents' age and reproductive age, as well as anthropometric measurements, were collected too.

2.3 Anthropometric measurements

Anthropometric parameters were measured according to the WHO standards [19]. The participants' height was measured to the nearest centimeter using a wall tape with their heels joined, straight legs, arms dangling and shoulders relaxed. The body weight was measured in kilogram to the nearest 100g, using a standard flail scale in women, lightly dressed and without shoes.

The waist circumference (WC) was measured on the respondents stand with feet 2.5 cm apart, legs straight, arms dangling and shoulders relaxed, the measuring tape was placed uncompressed at midway between the iliac crest and the last rib. For the hips (H) circumference, the participants were standing the feet joined and the measuring tape was placed around the buttocks at the level of the pubic symphysis and the fleshy part of the buttocks.

The calculation of the waist-to-hip ratio (WHR) has been made to better target the body fat distribution. The WHR values >0.85 indicate android morphotype and values of WHR <0.80 gynoid obesity morphotype in the study women. Participants with values 0.80≥ WHR≤0.85 were classified as intermediate or mixed morphotype [20].

The BMI was calculated by dividing the body weight in kg by the square of the height in meters (BMI = Body Weight (kg)/height (m^2)). Classified into the six BMI categories, according to the WHO [21], the participants were considered lean when BMI<18.5, normal weight when 18.5≤BMI< 25), with a risk of overweight if: 25≤BMI<30, obese class 1 when BMI≥30, obese class 2 when BMI≥35, and with morbid obesity if BMI≥40.

2.4 Statistical analyses

A descriptive analysis was conducted on participants' characteristics, namely sociodemographic variables, anthropometric measures as well as the perception of pain, stiffness and functional limitations following knee osteoarthritis and/or hip osteoarthritis.

The Pearson correlation was performed to assess the association of age with the three WOMAC dimensions, namely: pain, stiffness, and functionality perceived by the participants. The ANOVA test with The Bonferroni correction for multiple comparisons was applied using simultaneous confidence intervals to determine significant differences between the group means.

The data analysis was performed using SPSS for Windows (version 23.0).

2.5 Ethical consideration

Free and informed consent was obtained from all the participants who were informed about the study purpose and the possibility of interrupting their participation in the survey if they wish at any time. All collected data have been treated as strictly confidential.

3. Results

The survey involved a sample of 137 women from 11 urban and rural localities of El Jadida province. The respondents' average age was 45±13 years, the age group (35-50 years) being the most representative with a rate of 43.8%. The average BMI for our population was 29.18±5.29 and the WHR was 0.93±0.9. Women of childbearing age represented 51%, while the rate of menopausal women was 49%.

The baseline characteristics of the population sample are presented in Table 1. The calculation of the Pearson correlation coefficient between the 3 WOMAC dimensions and age showed a positive correlation of increased pain perception (r=0.431, p<0.05), stiffness (r=0.377, p<0.05) and lower limb functionality (r=0.381, p<0.05) with age increase.

Table 1: Correlation between age and WOMAC types in studied women

Variables		WOMAC Total	WOMAC Pain	WOMAC Stiffness	WOMAC Functionality
Age	R	0.414^{**}	0.431^{**}	0.377^{**}	0.381^{**}
	p-value	<0.001	<0.001	<0.001	<0.001

Values are Pearson correlation coefficient. ** Correlation is significant at the 0.01 level (two-tailed):
*, P≤0.05; **, P≤0.01; ***, P≤0.001.

As shown in Table 2, pain, stiffness, and functional discomfort were significantly more likely perceived in postmenopausal women than in those at reproductive age with respective averages (9.53±5.95 vs 5.61±5.0); (3.74±2.63 vs 2.47±2.36) and (31.08±19.55 vs 21.50±16.63). The p-value was significant in the 3 dimensions of WOMAC (p<0.05).

Table 2: Distribution of WOMAC dimensions by age of procreation

WOMAC types ^{a}	Procreation (n=70)	Menopause (n=67)	Total (n=137)	p-value
WOMAC Pain	5.61±5.0	9.53±5.95	7.53±5.81	0.000
WOMAC Stiffness	2.47±2.36	3.74±2.63	3.09±2.57	0.003
WOMAC Functionality	21.50±16.63	31.08±19.55	26.18±18.68	0.002
WOMAC Total	29.58±22.44	44.37±26.67	36.81±25.61	0.001

Values are expressed as mean and standard deviation
The mean difference is significant at the 0.05 level

Table 3 presents the risk location of osteoarthritis occurrence according to BMI classes. Results pointed out that 56.2% of the study women claimed not having osteoarthritis, with 23.4% of them being overweight. The hip osteoarthritis represented 16% of cases, 5% of them belonged to obesity class 1, while 9.5% reported having knee osteoarthritis. In addition, participants who claimed having both forms of osteoarthritis, accounted for 18.2% cases, among them 8% with obesity class 1.

Table 3: Distribution of WOMAC types by BMI group

BMI groups [b]	Asymptomatic	Coccyx osteoarthritis	Knee osteoarthritis	Both forms
Normal	12.4%	6.6%	3.6%	0%
Overweight	23.4%	2.9%	4.4%	4.4%
Obesity class 1	15.3%	5.1%	0.7%	8.8%
Obesity class 2	5.1%	0.7%	0.7%	2.2%
Morbid obesity	0%	0.7%	0%	2.9%
Total	56.2%	16.1%	9.5%	18.2%

[b] Values are expressed as percentage. For body mass index (BMI) groups: low BMI =< 18.5 kg/m^2; normal BMI = 18.5 to<25 kg/m^2; overweight BMI = 25 to <30 kg/m^2; obese class 1 BMI =>30 kg/m^2; obese class 2 BMI => 35 Kg/m^2; morbid obesity => 40.

Table 4 shows that there was no statistically significant association between BMI classes and the perception of WOMAC stiffness. However, for the other WOMAC dimensions, they were significantly more experienced by respondents with morbid obesity than those of other BMI classes for the pain (15.40±2.07; p=0.009) and functional impairment (48.80±16.48; p=0.024).

Table 5 indicates that participants with an android-like morphotype (WHR > 0.85) perceived respectively more pain (8.13±0.53) and functional impairment (27.97±1.71) of their lower limbs than those with gynoid (WHR <0.80) and mixed morphotype (0.80≥ WHR≤0.85) with respective averages of pain (6.14±1.92) (2.41±0.69) and functional impairment (22.71±6.05) (10.66±3.68). The results are significant for those dimensions of pain (p=0.004) and functional impairment (p=0.007).

Referring to Bonferroni comparisons, Table 6 shows a statistically significant difference between the groups' averages. Women with both forms of osteoarthritis feel more pain, stiffness and functional impairment than those with hip and knee osteoarthritis forms separately.

Table 4: Prevalence of different osteoarthritis locations by BMI class (%)

BMI	N	WOMAC pain		WOMAC functionality		Stiffness WOMAC		WOMAC Total	
		Mean	SD	Mean	SD	Mean	SD	Mean	SD
Normal weight (1)	31	6.12	5.5	23.12	18.12	2.41	2.41	31.67	4.40
Overweight (2)	48	6.87	5.4	23.81	17.37	3.12	2.54	33.81	3.42
Obesity class 1 (3)	41	8.58	5.8	29.75	19.12	3.29	2.56	41.63	4.11
Obesity class 2 (4)	12	6.91	6.3	22.00	18.80	3.16	2.75	32.08	7.63
Morbid obesity (5)	5	15.40	2.07	48.80	16.48	5 .20	2.94	69.40	8.27
Total	137	7.53	5.81	26.18	18.68	3.09	2.57	36.81	2.18
P-value		0.009		0 .024		0.219		0 .016	

BMI: body mass index; SD: standard deviation

Adjustment for multiple comparisons: Bonferroni. The mean difference is significant at the 0.05 level

For body mass index (BMI) groups: low BMI ≤18.5 kg/m^2; normal BMI = 18.5 to<25 kg/m^2; overweight BMI = 25 to <30 kg/m^2; obese class 1 BMI ≥30 kg/m^2; obese class 2 BMI ≥35 Kg/m^2; morbid obesity ≥40.

Table 5: Distribution of WOMAC dimensions by waist-hip ratio

WHR	N	WOMAC pain		WOMAC functionality		WOMAC stiffness		WOMAC Total	
		Mean	SD	Mean	SD	Mean	SD	Mean	SD
WHR < 0.80 Gynoid morphotype	7	6.14	1.92	22.71	6.05	3.00	0.92	31.85	8.46
0.80≥ WHR≤0.85 Mixed form	12	2.41	0.69	10.66	3.68	1.58	0.41	14.66	4.59
WHR > 0.85 Android morphotype	118	8.13	0.53	27.97	1.71	3.25	0.24	39.36	2.35
Total	137	7.53	0.49	26.18	1.59	3.09	0.21	36.81	2.18
P-value		0.004		0.007		0.099		0.005	

WHR: waist/hip ratio; WC: waist circumference; SD: standard deviation
Adjustment for multiple comparisons: Bonferroni. The mean difference is significant at the 0.05 level.

Table 6: Distribution of WOMAC according to the different locations of osteoarthritis

WHR	N	WOMAC pain		WOMAC functionality		WOMAC stiffness		WOMAC Total	
		Mean	SD	Mean	SD	Mean	SD	Mean	SD
Asymptomatic (1)	77	5.46	0.62	18.36	1.87	2.49	0.27	26.32	2.61
Hip osteoarthritis (2)	22	8.72	1.05	34.36	3.92	2.40	0.51	46.27	5.16
Knee osteoarthritis (3)	13	9.46	1.55	34.23	4.70	4.23	0.77	47.92	6.46
Both forms (4)	25	11.84	0.95	38.92	2.94	4.28	0.49	55.04	4.11
Total	137	7.53	0.49	26.18	1.59	2.57	0.21	36.81	2.18
P-value		0.000		0.000		0.006		0.000	

Adjustment for multiple comparisons: Bonferroni. The mean difference is significant at the 0.05 level.

4 Discussion

Obesity is characterized by an increased amount of body fat and considered as a risk factor for several chronic diseases such as diabetes, hypertension, and osteoarthritis[22]. Our study was carried out on women from an agricultural community in El Jadida province, aged 45.35±13.11 years old. For 44% among them the age was ranged 35-50 years. In this population, the prevalence of overweight accounted for 35% and obese women exceeded 42%. These results indicated an increase of fat mass in this population with age and warn of an increase in obesity-related diseases in the future.

The data reported here showed that the WOMAC sensation of pain, stiffness and functional discomfort were significantly perceived by this population and the effect was increased with age and at menopause. The susceptibility of osteoarthritis occurrence in its both forms was much more manifested in the age group of more than 50 years with a rate of 22% against 18% in the 35 to 50 years age group. Our results are corroborated by the data from a meta-analysis reporting evidence of increased osteoarthritis prevalence with age [23]. Another major US study on the prevalence of osteoarthritis by Ma *et al.* also found a higher risk in women of 50 to 55 years old [24]. Moreover, from this age, body weight gain is one of their major health concerns [25]. This is conceivable as obesity is one of the most common nutrition-related disorders globally, and its prevalence is increasing [26]. Additionally, at this critical age in women, the severity level of the knee injuries is more advanced in those at menopause than in men [27].

Our results showed also a significant association between BMI and WOMAC with significantly greater pain and functional impairment in women with morbid obesity averaging 15.4 and 48.8 respectively. These results are in accordance with those reported by other studies [28-30]. Indeed, several studies suggest that obesity accelerates the progression of knee osteoarthritis and that an increase of five units of BMI is significantly associated with an increased risk of developing knee osteoarthritis. Each increase of five BMI units is associated with an increased risk of 35% knee osteoarthritis [31]. According to the Framingham study, it appears that the risk of developing knee osteoarthritis is directly related to average BMI between 36 and 40 years [32]. In fact, overweight precedes osteoarthritis of the knee for several years and may aggravate preexisting osteoarthritis [33-35]. Conversely, weight loss reduces the risk of knee osteoarthritis [36]. American College of Rheumatology and EULAR recommend weight loss in the medical treatment of knee osteoarthritis [37]. A loss of about 5 kg, in the previous 10 years, can reduce the risk of knee osteoarthritis by 50% and the loss of 1 kg of body weight can reduce by a factor of more than 2 the maximum compressive load in the knee [38].

In addition to the increased risk of knee osteoarthritis associated with higher BMI, a study reported that the increased risk of knee osteoarthritis was directly related to increased weight [39]. In fact, it has become clear that the development of osteoarthritis is also linked to adipose tissue, due to excess body weight and mechanical stress on the cartilage [23].

Unlike knee osteoarthritis, no association between obesity and the progression of hip osteoarthritis was found in our investigated population. Nor was it significant in another Rotterdam cohort study that analyzed the impact of BMI on the progression of hip and knee osteoarthritis [40]. Nevertheless, our results point to a positive association between the increase of BMI and the risk of osteoarthritis in both forms (knee osteoarthritis and hip osteoarthritis).

Moreover, many transverse and longitudinal epidemiological studies highlighted a significant link between the BMI and the incidental risk of developing osteoarthritis [41]. Body fat distribution is important given the adverse consequences of obesity on health, especially intra-abdominal fat accumulation [42]. However, few studies have been interested in waist/hip ratio (WHR) as poor distribution of body fat is frequently associated with (mechanical) complications, responsible of articulation pathologies (in particular knee and hip osteoarthritis) [8]. In our study, the pain and the functional impairment perceived by the WOMAC are much more expressed among women with WHR>0.85 and less felt in those with android-like obesity (WHR<0.80). Thus, the comparisons using Bonferroni test proves a very significant link between WHR and the perception of three WOMAC dimensions according to the different localizations of osteoarthritis. Our results are consistent with the hypothesis that abdominal accumulation of fat mass could cause mechanical complications especially the gynoid form responsible for articulations diseases such as knee osteoarthritis and hip osteoarthritis [8].

5 Conclusion

Our results show the involvement of obesity in the etiology of osteoarthritis. It is a real public health issue that requires a large-scale prevention strategy. In addition, its extent varies according to age and osteoarthritis localization. The data point to the importance of preventing the pain, stiffness and the disability associated with osteoarthritis, through the management of obesity.

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Conflicts of interest

The author declares no conflicts of interest.

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